Chapter 11
Restoration of Deforested and Degraded Areas in Africa

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11.1 Introduction

Deforestation and degradation of the remaining forests threatens the lives and livelihoods of millions of people in Sub-Saharan Africa (SSA), especially those residing in the rural areas. Deforestation is the removal of forest cover and conversion to other land uses such as agriculture. Degradation is defined as a permanent decline in the productive capacity of the land (Stocking and Murnaghan 2001). Although a worldwide problem (Williams 2003), deforestation and degradation is said to be most acute in SSA where it is characterized by decreasing production of forest products (timber and non-timber) and increasing food insecurity, leading ultimately to worsening levels of poverty and malnutrition. Wide-spread poverty in many countries places many people facing food insecurity even in good times (Dixon et al. 2003). Deforestation and degradation is occurring throughout SSA as a result of a complex interplay among anthropogenic and environmental factors (e.g., Asante 2005; Bongers and Tennigkeit 2010). For example, the rain forests of West Africa are said to be disappearing at the rate of 5% annually with nearly 90% of the original moist forests gone or remaining as fragmented or degraded remnants (FAO 2001a).

Forest landscape restoration in SSA is undertaken in the context of a mosaic of shifting agriculture or land-uses that ranges from intact forest to permanently cleared cropland with a diversity of agroforestry mixtures between. In this chapter, I present an overview of the direct and indirect (proximate and underlying, *sensu* Geist and Lambin 2002; Kanninen et al. 2007) drivers of deforestation and degradation in SSA. Techniques for restoration are briefly introduced and illustrated with case studies from several countries.

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11.2 Background

Sub-Saharan Africa covers an area of 13.9 million km^2 or about 46% of the continent and is home to some 600 million people (WRI 1998) living in a variety of physical, cultural and economic environments. SSA can be broadly classified into three zones comprising humid lands, sub-humid lands and dry lands based mainly on the aridity index (AI) of climate. The AI is derived from the ratio of mean annual precipitation (P) to mean annual potential evapotranspiration (PET) (UNDP/UNSO 1997).

Based on this criterion, humid lands are those with an AI value greater than 1.0. Vegetation in these humid areas is tropical rain forests that develop in low land areas with year-round precipitation. It extends throughout the Congo (Zaire) basin and along the west coast of Africa with its widest coastal extent in Sierra Leone. It is also found in a narrow belt along the southeastern coast south from the equator. Generally, a heavy canopy of foliage with lianas and epiphytes characterizes the rain forest. It occurs in regions where high temperatures are combined with heavy precipitation. The island of Madagascar has a unique rain forest with special species of fauna and flora not found on the continent.

Sub-humid lands fall into two categories of moist sub-humid (AI of 0.65–1.0) and dry sub-humid (AI of 0.5–0.65). Vegetation in these areas is tropical grasslands or savanna. The margin of the savanna coincides with the rain forest belt where dry conditions begin. In such areas, there is often a mosaic of forest savanna. Further away from the forest, as the dry season becomes more pronounced and prolonged, the savanna woodland thins out, and trees that are more drought resistant are found. Generally, the prevailing vegetation cover is grass interspersed with trees (except in areas around streams and moist hollows).

In the zone of lower rainfall the huge baobab tree illustrates storage of water while ‘umbrella’ trees (*Acacia* spp.) show adaptation to dry wind. Acacias, some producing gum, are a feature of the drier Sudan savanna. The savanna extends with similar differences in character over the Lake Plateau across the Zambezi River to the Drakensberg and dries towards the Kalahari Desert in the thorny scrubs of the Bushveld. Dry lands have been subdivided into three categories of semi-arid (AI of 0.2–0.5), arid (AI of 0.05–0.2) and hyper-arid (AI <0.05), AI values of <1.0 indicate an annual moisture deficit (Middleton and Thomas 1997).

In areas farther north, the savanna degenerates into semi-arid and then desert. This is the environment of the Sahel ranging from thorn, wooded grassland to tussock grasses with large patches of bare earth between. Human and animals overpopulate the semi-arid areas and both take their toll on the environment. As pasture is destroyed through overgrazing and cultivation, the desert advances southward further restricting populations and increasing densities in a vicious cycle of desertification.

Deforestation rates over the 10-year period 1990–2000 in the humid zone countries are shown in Table 11.1. Studies within the Miombo woodlands of the semi-arid

Table 11.1 Forest cover change (1990–2000) in Humid zone countries in sub-Saharan Africa

Country	Total forest area in 1990 (10^3 ha)	Total forest area in 2000 (10^3 ha)	Forest cover change, 1990–2000 Annual change (10^3 ha)	Forest cover change, 1990–2000 Change over the period (%)
Benin	3,349	2,650	–70	–20.9
Cameroon	26,076	23,858	–222	–8.5
Central Africa Republic	23,207	22,907	–30	–1.3
Comoros	12	8	0.4	–33.3
Congo	22,235	22,060	–18	–0.8
Cote d'Ivoire	9,766	7,117	–265	–27.1
Dem. Rep. of the Congo	140,531	135,207	–532	–3.8
Equatorial Guinea	1,858	1,752	–11	–5.7
Gabon	21,927	21,826	–10	–0.5
Ghana	7,535	6,335	–120	–15.9
Guinea	7,276	6,929	–35	–4.8
Guinea-Bissau	2,403	2,187	–22	–9.0
Liberia	4,241	3,481	–76	–17.9
Madagascar	12,901	11,727	–117	–9.1
Nigeria	17,501	13,517	–398	–22.8
Sierra Leone	1,416	1,055	–36	–25.5
Togo	719	510	–21	–29.1
Uganda	5,103	4,190	–91	–17.9

Source: FAO 2001a

zone also reveal high rates of deforestation. In the SADC[1] region for example, Shaba (1993) estimated that about 600,000 ha of indigenous forests are being cleared annually for other land uses. Table 11.2 illustrates generally high deforestation rates ranging from 100,000–532,000 ha between1980 and 2000. A more recent analysis suggests these are overestimates (Kelatwang and Garzuglia 2006). Forest area changes by sub-region for three dates are shown in Fig. 11.1. Five countries (Sudan, DR Congo, Zambia, Tanzania and Angola) account for almost half (48%) of the annual net loss between 2000 and 2005 (Kelatwang and Garzuglia 2006).

A recent assessment by FAO attempted to quantify the extent of deforestation in Africa by conversion to different land uses (FAO 2001a). Based on this study, 4% of deforestation was due to shifting cultivation, 8% through intensification of agriculture in already shifting agricultural areas, 60% as direct conversion of forest area to small-scale permanent agriculture, 12% as direct conversion of forest area to large-scale permanent agriculture and 17% for other purposes such as settlements. Nevertheless, there have been slight gains in forest cover in some countries mainly as a result of afforestation, e.g. in the Gambia and Swaziland (FAO 2001a).

[1]SADC or Southern African Development Community countries are Angola, Botswana, DR Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

Table 11.2 Forest cover changes in selected countries in semi-arid areas of eastern Africa since 1980

Country	Total forest cover (10^3 ha)			Annual deforestation rate			
	1980	1990	1995	1980–1990		1990–1995	
				Area (10^3 ha)	%	Area (10^3 ha)	%
Angola	24,812	23,385	22,200	−143	−0.6	−237	−1.0
Malawi	4,011	3,612	3,339	−40	−1.0	−55	−1.6
Mozambique	18,683	17,443	16,862	−124	−0.7	−116	−0.7
Tanzania	37,936	34,123	32,510	−381	−1.0	−323	−1.0
Zambia	35,931	32,720	31,398	−321	−0.9	−264	−0.8
Zimbabwe	9,506	8,960	8,710	−55	−0.6	−50	−0.6

Source: WRI 1998, FAO 1999, FAO 2010, and Nduwamungu 2001

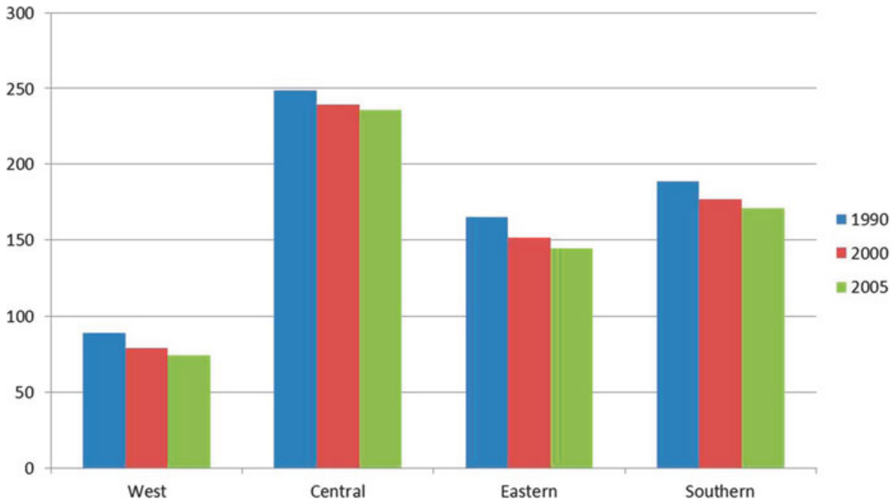

Fig. 11.1 Change in forest area (10^6 ha) on three dates by sub-region (Source: Kelatwang and Garzuglia 2006)

Within the dry lands zone, land degradation or desertification is reported to be occurring at various levels depending on vulnerability due to soil qualities and rainfall variability and land use (Reich et al. 2001). For example, it is moderate in irrigated croplands (1.9 million ha or 18% of total irrigated cropland) while it is high in rain-fed croplands and rangelands (48.9 million ha or 61% of rain-fed croplands and 995.1 million ha or 74% of rangelands) (INFORSE 1998). The annual rate of desertification is about 10% in arid lands, 1% in semi-arid lands and 0.1% in dry sub-humid lands, leading to an annual increase of lands affected of 156.9 million ha in arid areas, 23.0 million ha in semi-arid areas and 1.3 million ha in dry sub-humid areas. These give an average rate of desertification of 3.5% per year.

However, a word of caution is needed when discussing the extent of land degradation. Whereas it is generally agreed that degradation is taking place in SSA,

the actual magnitude of such degradation remains uncertain due to lack of reliable data on areas, stocks and yields (Misana et al. 1996). It is also widely known that owing to high variability in climatic conditions (especially rainfall amount and distribution) accompanied by drought and anthropogenic factors, dry land boundaries due to degradation are shifting over time (Tucker et al. 1991; Helden 1991). This raises a number of questions, notably the choice of suitable and harmonized methods for generating data and the appropriate frequency for monitoring changes, given the dynamism inherent in the climatic regions and the limited technical capacity within SSA to generate data and monitor trends. These are issues that need to be addressed.

11.2.1 Impacts of Land Degradation

In Africa, trees play an important role in protecting the environment. They are the principal source of rural energy, and provide countless medicinal and industrial products used in both the home and in small-scale industry. They often supply food and feed, are the main source of building materials in the countryside and, directly and indirectly, are a source of employment and income for many rural Africans.

Also many African countries have already lost a significant quantity of their soils to various forms of degradation. Soil degradation caused by deforestation is a serious threat in Africa. Deforestation exposes the soil to high temperatures which break down the organic matter, increase evaporation and make the soils vulnerable to erosion. Thirty-seven 10^6 ha of forest and woodlands in Africa are said to be disappearing each year (FAO 1986). More serious still is the gradual removal of trees in farms and pastures, which are crucial for protecting productive land from erosion. Many areas in the continent are said to be losing soil at over 50 Mg ha^{-1} year^{-1}. This is roughly equivalent to a loss of about 20 billion Mg of nitrogen, 2 billion Mg of phosphorus and 41 billion Mg of potassium per year. Serious erosion areas in the continent can be found in Sierra Leone, Liberia, Guinea, Ghana, Nigeria, Zaire, Central African Republic, Ethiopia, Senegal, Mauritania, Niger, the Sudan and Somalia.

Desertification is a serious problem in the continent. It has been estimated that 319 10^6 ha of Africa are vulnerable to desertification hazards due to sand movement. An FAO/UNEP (2010) assessment of land degradation in Africa suggests that large areas of countries north of the equator suffer from serious desertification problems. For example, the desert is said to be moving at an annual rate of 5 km in the semi-arid areas of West Africa.

In the drier parts of Africa, millions of hectares of grazing land and rangeland are also threatened with degradation- in the arid north, the semi-arid south, and the Sudano-Sahelian countries and in the drier parts of Cameroon, Ethiopia, Kenya and Nigeria. The 1983–1985 and recent droughts killed huge numbers of livestock there, with the result that good breeding stock was lost and the structural balance of herds distorted. Nevertheless, the herds are now recovering, but within 5 or 10 years the

trend of increasing overgrazing could be re-established – until the next drought reduces livestock numbers again.

The rangeland itself has been changed for the worse, with many of the perennial grasses being replaced by nutritionally poorer annual grasses. This has permanently impaired the rangeland's potential for recovery and decreased its carrying capacity. As the vegetation has been removed or reduced, the wind has also winnowed out the small amount of silt that the soil contains, reducing its ability to retain moisture. When it does rain, the chances of the range recovering are correspondingly reduced.

11.3 Causes of Deforestation and Degradation

11.3.1 Direct Causes

Causes of loss and degradation of forest cover can be classified into direct and indirect or underlying causes (Geist and Lambin 2002; Kanninen et al. 2007). Direct causes are agricultural expansion and intensification, wood extraction, mining, and infrastructure expansion. Fire-adapted ecosystems are widespread in the drier vegetation zones of SSA but wildfires purposely set by hunters, loggers, grazers or arsonists or escaped from agricultural burning are outside of the normal range of occurrence (Appiah et al. 2010).

11.3.1.1 Shifting Cultivation

Traditional shifting cultivation is the leading cause of deforestation in the SSA (Fig. 11.2) accounting for 70% of the woodland converted (FAO 1982). In addition, fires often set by shifting cultivators and other forest dwellers are a major cause of forest degradation and impede regeneration of woody plants (Rowe et al. 1994). Thus shifting cultivation leads to loss of timber and non-timber species accompanied by altered nutrient cycling, thus affecting the productivity of the ecosystem. This traditional agriculture also results in mining soils of plant nutrients by removing crop residues, leaching, and soil erosion (Smaling et al. 1997). Nevertheless, shifting cultivation was a sustainable adaptation to low native soil fertility under traditional intervals between cropping and fallow. Population pressure reduced the interval and the traditional system became unsustainable (Nye and Greenland 1960; Lal 1989).

11.3.1.2 Abandonment of Farms

Sometimes permanently cultivated farms for food or cash crops are abandoned because of low yield due to low nutrient availability of the soil and the inability of farmers to provide mineral or organic fertilizers due to high cost or lack of availability. Such

Fig. 11.2 Degradation due to shifting cultivation

areas turn to become degradation areas because there is no maintenance and management. Farm gardens are sometimes established on banks of streams and rivers where food crops and tomatoes are cultivated. These activities can lead to siltation of the streams and rivers and reduce stream flow and the availability of water for the local communities.

11.3.1.3 Overgrazing

Overgrazing of herbage is an important cause of woodland degradation in the subhumid forests/woodlands ecological zone. Overgrazing in these areas is mainly due to large herds of cattle arising from unwillingness among livestock owners to manage and reduce stock during drought periods and that most of the forests/woodlands are open access (not reserved). The consequences of overgrazing have been land degradation (soil compaction, broken soil crust and erosion) as well as reduced species diversity and density. In the miombo woodland the presence of tsetse fly in some miombo woodlands that transmits trypanosomiasis to cattle has limited the rearing of cattle some areas.

Studies in the miombo woodlands of Zimbabwe have shown that, heavy browsing significantly reduced the biomass of *Julbernardia globiflora* and in Zambia, heavy browsing within 2 years led to the death of coppiced stumps of *Brachystegia spiciformis* and *Baphia bequaertii* (Chidumayo et al. 1996). In Malawi, heavy browsing has been found to be detrimental to tree regeneration especially of preferred species (Chidumayo et al. 1996). Livestock management strategies based on rangeland fencing (e.g., *Ngitilis* in Tanzania) often conflict with wildlife management by preventing seasonal migration of wide-ranging animals. In upsetting the ecological balance such enclosures compel both domesticated and wild species to overgraze their respective fodder bases, thereby contributing to further vegetation and soil degradation (Rowe et al. 1994).

Fig. 11.3 Loading bay of a legal logging system

11.3.1.4 Commercial Logging

Both legal and illegal logging can lead to reductions in plant species and decrease biodiversity. However there is some regional variation in the relative contribution of commercial logging to loss of forests and woodlands in the sub-humid lands of SSA. It has been estimated that 20% of productive tropical African forests were logged by 1985 (Rowe et al. 1994). Commercial logging can damage as much as 53% of the remaining smaller trees, destroy as much as 50% of the original forest and disturb 40% of the topsoil (Struhsaker 1987). In addition loading bays (Fig. 11.3) that are created for loading of timber also leads to loss of timber and non-timber species as well as destruction of chemical and physical properties of the soil. Other effects include suppression of regeneration by weeds or failure to regenerate and damage to the watershed functions of the forests (Kaoneka and Solberg 1994). Modern methods of reduced impact logging can reduce the damage to residual stands and avoid the gross forms of degradation (Putz et al. 2005). In some countries attempts to control harvesting or export bans have led to illegal logging by pit sawyers to meet local demand for construction lumber (Hansen and Treue 2008). Because pit sawyers use inefficient methods that generate much waste, they require more raw materials to produce the desired volume of lumber and thereby causing more trees to be harvested than is necessary (Marfo et al. 2010). Wildfire impacts in ecosystems as a whole including killing of timber and non-timber species. It also affects the soil physical and chemical properties and hence leads to general reduction and productivity of the forest ecosystem (Figs. 11.4 and 11.5).

Some private developers have cleared large tracts of forest with the objective of establishing agricultural or forest plantations. However, due to financial constraints most of these areas are left unplanted and invaded by invasive plants like

Fig. 11.4 Forest landscape degraded by fire

Fig. 11.5 Forest landscape degraded by fire

Chromolaena sp. The productivity of such areas becomes reduced and often more fire-prone (Figs. 11.6 and 11.7). In some countries, native forests have been converted to oil palm or rubber plantations (Hance and Butler 2011). Many African countries have a history of conversions to exotic timber species such as *Pinus*, *Eucalyptus*, and *Acacia* species.

Fig. 11.6 Degradation due to unplanted site cleared for plantations

Fig. 11.7 Live tree being killed by farmer

11.3.1.5 Firewood Gathering and Charcoal Making

In many developing countries, 90% of all wood is used for firewood for cooking and heating and domestic uses such as building poles and fencing materials (Evans 1992). The consumption of firewood ranges between 0.5 and 2.0 m^3 $person^{-1}$ $year^{-1}$

Fig. 11.8 Dead wood cut into pieces and packed

(Evans 1992). Firewood gathering and charcoal making have contributed significantly to forest destruction and land degradation in the sub-humid zone of SSA. Rapid population increase and fast rate of urbanisation have increased the demand for these products while poverty has prevented transition to other sources of energy (Struhsaker 1987; Monela et al. 1993). Furthermore, wood is inefficiently utilized using unimproved firewood and charcoal stoves. As a consequence firewood use in Africa increased from 290 10^6 to 410 10^6 m^3 per year between 1970 and 1982 (Evans 1992). Acute firewood scarcity (i.e. supplies not meeting demand even with over cutting), in 1980 affected 96 10^6 people in 23 countries, including those in sub-humid areas of SSA (Evans 1992). As a consequence, some communities are using cow dung and agricultural residues for cooking instead of leaving both to improve fertility of farm plots.

Charcoal is one of the major products in sub-humid forests and provides an important income for rural dwellers. According to CHAPOSA (1998) charcoal production has become one of the major income sources for rural people in areas where transportation to the big cities is possible (Figs. 11.8, 11.9 and 11.10). In southern Mozambique for example, 70% of the cash income was from charcoal. In Tanzania, 75% of the farmers in studied areas had charcoal as an important source of income. In Zambia, with the collapse of the agriculture market, charcoal is virtually the only income source in rural areas. Studies in three major cities (Lusaka in Zambia, Dar es Salaam in Tanzania and Maputo in Mozambique) revealed that woodland cover has been reduced during the study period partly due to charcoal production and partly due to increased cultivation. During 1989–1998, forest resources for charcoal production in Lusaka, Dar es Salaam and Maputo areas reduced by 25% (from 32 to 17%), 22% (from 22 to

Fig. 11.9 Charcoal kiln made of a pile of wood covered with grass and soil

Fig. 11.10 Charcoal harvested from kiln

Fig. 11.11 Degraded mine site with deep trench filled with water and mine spoils or dumps

17% of area covered) and 74% (from 3 to 1%) respectively. Fuelwood and charcoal making leads to reductions of essential tree species and loss of biodiversity through ever-exploitation (Figs. 11.8, 11.9, 11.10 and 11.11). Recent studies in Malawi and Zambia have further documented the reliance of most of the urban population on charcoal (Kambewa et al. 2007; Mwitwa and Makano 2012) and the impacts are exacerbated by the use of inefficient charcoal kilns.

11.3.1.6 Mining

Mining operations, especially by illegal or small-scale miners popularly known as *galamsey* in Ghana (Hilson 2002), lead to destruction of timber and non-timber species. Their activities also lead to destruction soil physical properties and hence reduction in soil fertility. The poisonous chemicals used in their operations also pollute the streams and rivers in the rural areas where their operations are carried out (Figs. 11.11 and 11.12).

11.3.2 Underlying Causes

The underlying causes of degradation vary greatly from country to country but generally include land insecurity due to conflicting rights to land under customary versus legal tenure systems; expanding human populations mostly dependent on agriculture; and weak institutional protection for forest areas.

11.3.2.1 Land Tenure Systems

The most controversial issues related to land in almost every country in Africa especially in West and Central Africa revolve around ownership and access to land.

Fig. 11.12 Degraded mine site with deep trench filled with water and mine spoils or dumps

The system of land ownership determines access to land and land security and property rights determine investment in land. This in turn affects land use practices in general and therefore the rate and intensity of land degradation. Land tenure systems are the laws and regulations – modem and traditional regarding the ownership and accessibility of land resources in any given country or area. In some countries, current land tenure practices are not favorable for reducing and eventually controlling land degradation because such practices do not promote effective land management. Traditional law on land recognizes the land resource as a communal property to be shared by all members of society. This reduces both the responsibility of the individual in land management and any incentive for investment.

11.3.2.2 Demographic Pressures

The average annual population growth rate for countries in the West and Central African region is estimated at 3%. About 50% of the population in the region is below the age of 15 years. This results in an unduly large percentage of dependent population and resulting pressure on land resources due, among other factors, to the need to produce more food through existing extensive shifting agricultural systems. If no rational population policies are adopted by governments in the region, the total population of West and Central Africa will reach 385 million by 2025, negatively affecting land, food availability, social services and the environment in general (World Bank 1997).

Rapid population growth is one of the root causes of poverty and forest resource degradation in Africa. The rapid population growth, coupled with internal migration, also accounts for the high rate of forest degradation. In most parts of Africa as the population density increases and land becomes scarcer, its value rises and farmers then find it cost-effective to intensify production. Others resort to clearing

virgin forest for additional cultivation of cash crops especially in the humid zones. The poor and landless peasant farmers tend to be pushed onto ecologically sensitive areas with low agricultural potential (for example semi-arid savanna, erosion-prone hill sides and tropical forests). The situation is aggravated where large-scale farmers respond to growing pressure to expand primary commodity export like cocoa and cashew and thus enlarge the areas on which cash crops are grown.

11.3.2.3 Lack of Alternative Employment Policies

The majority of people in West and Central Africa depend on the land for their livelihood, specifically through farming, animal husbandry, small-scale mining or collecting materials for handicraft. With the increasing cost of living in the region, coupled with the increasingly unsustainable nature of natural resource-based activities, and in view of the need for food security and the improved well-being of the population, alternative employment policies have been proposed as a solution. These policies should provide for the needs of the increasing number of secondary and tertiary school-leavers, most of whom are unemployed. Alternative employment policies based on processing industries, trade and handicraft could ease pressure on land and offer opportunities to people to generate extra income. In particular, processing industries could concentrate on food processing and – for those countries endowed with forests – wood processing.

For such policies to succeed, however, governments should address the problem of people's inadequate capacity to embark upon new ventures. Concerned populations must be assisted, through training and the provision of micro-capital, to adapt to new opportunities. For example, the well-known entrepreneurial capacity of women in West Africa should be promoted.

11.3.2.4 Perverse Incentives

Both macroeconomic and sectoral policies rely heavily on the use of economic instruments to achieve their goals. These economic instruments – such as taxes, subsidies, price controls, markets, loans, credit arrangements, interest rates and exchange rates all aim to manipulate profits and returns so as to make particular sectors and economic activities attractive to producers and consumers, and to stimulate output, employment and income. This has also had impacts on the forest sector, because it influences the relative profitability of other land and resource uses often at the cost of forests, which often discouraged community involvement in sustainable forest management.

The example of economic instruments used in support of agricultural policy goals is well documented, and has arguably had the most detrimental effect on forests, and on community involvement in sustainable forest management, in Eastern and Southern Africa. In the pursuit of national goals of food security, rural income generation and export earnings, the agricultural sector has long been promoted as a

key source of development and growth. A range of economic instruments have been used to improve the profitability of, and stimulate the output of, activities such as ranching, grain production, export cropping and irrigated agriculture.

These economic instruments have involved manipulating fiscal, financial, price and market mechanisms such as through the imposition of relatively lower tax rates on agricultural land-uses, subsidies to inputs, government intervention in marketing, preferential credit arrangements, relief on taxes and duties, and high spending on research, extension, development and marketing. By artificially inflating the profitability of agriculture, this has encouraged the spread of farming activities, often at the expense of forests. It has also exerted a strong influence on the relative desirability of different land and resource uses at the community-level, making sustainable forest-based activities appear to be less economically desirable, and substantially increasing the agricultural opportunity costs of maintaining land under forest cover. Although the case of agriculture is perhaps the most extreme, and well-documented, similar examples of sectoral economic instruments that act as perverse incentives against community involvement in sustainable forest management exist in other sectors of the economy—for example in land, industrial mining, water and energy sectors.

11.3.2.5 Weak Forestry Sector

The failure of the Forest Authorities to adequately control and manage the forest sustainably has resulted in large-scale encroachment on protected areas such as forest reserves. Weak administrative machinery to monitor and patrol the forest is also the underlying factor for increasing bush fire in the forest areas. The weak administrative machinery may also be the result of inadequate funding for the operations of the forest authorities.

The weak administrative machinery is often a measure of the gap between projected revenues and what is actually collected, or the ability to generate enough revenue to cover the cost of operation. The income generating ability of the forest authorities determines the efficiency in managing the forest. Service authorities are therefore unable to cover the full cost of forest management. It cannot acquire the basic equipment needed for forest management and monitoring. This gave rise to widespread illegal timber operations across the countries in Africa.

Although the activities of most agencies in the other sectors of the economy like agriculture, mining, road infrastructure and population have direct impact on the forest resource base, yet there are no mechanisms for coordinating the activities of these institutions. Lack of effective coordination and communication has resulted in increased assault on the forest resource base, which has contributed to its fast degradation.

11.3.2.6 Low Forest Taxes & Fees Regime

Forest revenue is generated mainly through royalties, rental fees and silvicultural charges. From the economic point of view often in the timber industry, a substantial

residual economic value remains (before tax) after accounting for production costs and imputing sufficient profit to sustain the enterprise over the long term. This residual value or stumpage value in reference to the value of the standing timber is the maximum price a logger would be willing to pay under competitive conditions to the government. If the government leaves a large proportion of the stumpage uncollected, perverse economic incentives sets in to influence the rate of log harvesting. Thus the forest revenue regimes have a critical role in determining the rate of environmental decay.

Most forest authorities in Africa have frequently established inappropriate forest revenue systems in which the timber royalties do not cover the cost of managing the forest. The forest fees do not cover the full economic cost neither does it cover full operating cost. Until recently, timber royalties were charged per tree and value was estimated at less than 2% FOB[2] price per m^3 of round log multiplied by the average tree volume of the species at the minimum felling diameter. The system is inefficient as a mechanism for recovering stumpage value, thus promoting wastage both in the forests and mills.

An analysis of the forest fees in Ghana for example shows that forest fees have been too low in absolute terms to protect the resource or slow down exploitation. The current system has resulted in an inadequate market incentive differentiation between species, thus leading to over-exploitation of highly desirable timber species and under-exploitation of abundant but less-desirable species (FAO 2001b).

11.3.2.7 Lack of Investments in the Forestry Sector

Investments in the forestry sector can have an indirect pressure on the forest. Where people fail to invest in timber plantations, it exerts undue pressure on the natural forest since the demands of the installed milling capacity exceeds the supplies for the forest. In the past the private sector failed to invest in the timber plantations for almost a century and the natural forest continued to be the source of raw materials for the milling industry that had over-capacity.

11.3.2.8 Lack of Stakeholder Participation in Forest Management

In most countries in Africa rural communities live very close to the forest and are major and direct consumers of the goods and services from the forest; especially the non-timber forest products. They are the major and direct cause of deforestation and other forms of ecological and environmental damages. Thus their exclusion from forest management through policy gives them little incentive to be trustees of the forest resources. There is evidence that the rate of deforestation has seemingly declined since the concept of community participation in forest management was introduced about a decade ago (FAO/UNEP 2010).

[2] Freight on board.

11.4 Techniques for Forest Landscape Restoration

11.4.1 Protection of Remnant Forests

The first line of defense against deforestation and degradation is to protect the remaining forest area. In many countries, there are remnant patches of forest set aside by traditional authorities or local communities for sustainable resource use to improve their livelihood and the preservation of vital biodiversity. There are varying names for these forests depending on the communities in which they are found. All these remnant forests are rehabilitated through a community-based management system with the underlying principles being the traditional resource management systems. In Ghana, for example, these areas have different names in different cultures, but are often referred to as sacred groves, fetish groves, local forests or community forests. Some such forests are designated as burial grounds for chiefs or as the home of local deities. But in most cases they are intended to protect watersheds, fragile ecosystems, and plants and animals of conservation importance to local communities.

Traditional authorities are usually the title holders of such areas, and exercise general administrative functions over them. But the management, defense and preservation of such lands are the responsibility of the entire community. Societies issued controls and sanctions to protect them, and these reserves are intact today in places where culture and traditional religions remain strong. In such reserves, the community forests or sacred groves now support a much larger variety of plant and animal life than do surrounding areas, providing vital products and services such as building materials, timber products, fuel wood, fruits and nuts, bushmeat, snails, mushrooms, and most importantly, plants that are used as traditional medicines. Harvesting is strictly selective there, controlled and allowed only at time intervals that benefit and satisfy the entire community.

On its part, the community adheres to traditional norms and regulations governing the management of these forests, as well as local norms and beliefs governing sacred or fetish groves which prohibit harvesting forest products. Entry is allowed only on specific days or periods for the performance of rituals. Most such groves are believed to contain the “earth god” or spiritual beings that promote peace and prosperity and check antisocial behavior, and have resulted in remnant patches of primordial forest even in densely populated areas.

In some areas where traditional authority is strong, local chiefs may restrict cutting live trees even for firewood (Stanturf, personal communication 2012). Nevertheless encroachment by groups outside of a chief’s authority may occur, especially within 10 km of major roads. Encroachment even into protected forests is common where charcoal production and sales is a major livelihood activity (Kambewa et al. 2007; Mwitwa and Makano 2012).

11.4.2 Restoration Methods

A number of techniques are available to reverse or mitigate the effects of degradation and choice of an appropriate method depends on (Lamb 2010; Stanturf 2005):

- The priorities and objectives of stakeholders,
- The costs and benefits associated with available rehabilitation techniques, and
- The economic, social, and environmental values of the land resources in their current and desired future states.

Forest landscape restoration focuses on re-establishing functions and key ecosystem processes across a whole landscape rather than at just planting or restoring individual sites. Nevertheless, restoration usually involves planting or otherwise manipulating existing vegetation. The kind of trees planted, planting density, and long-term maintenance of the restored forest will depend on whether the restored area is within a protected or otherwise designated area or on customary lands mixed with agriculture. A necessary measure in all restoration projects in Africa is to address the local drivers of degradation by providing alternative livelihoods or improved agricultural practices. The major techniques that have been used in Africa for restoration of degraded landscapes include (Blay et al. 2004):

- Plantations,
- Agroforestry,
- Physical structures for soil and water conservation
- Natural regeneration,
- Assisted natural regeneration (ANR), and
- Enrichment planting.

11.4.2.1 Plantations

Planting trees or shrubs as single- or mixed-species on degraded lands can catalyze forest succession in the understory, particularly on sites where persistent ecological barriers to succession would otherwise preclude re-colonization by native forest species (Lubbe and Geldenhuys 1991; Geldenhuys 1993, 1996; Fimbel and Fimbel 1996). The catalytic effect of plantations is due to changes in understory microclimatic conditions, increased vegetation structural complexity, and development of litter and humus layers that occur during the early years of plantation growth. These changes lead to increased seed inputs from neighboring native forests (and sometimes also from nearby exotic or weedy species) by seed dispersing agents, suppression of grasses or other light-demanding species that normally prevent tree seed germination or seedling survival, and improved light, temperature and moisture conditions for seedling growth.

There is increasing evidence that mixed-species plantations are more effective for rehabilitation than the use of single-species plantations due to their high potential for biomass production and attraction to animal seed dispersers as well as

increased soil fertility and soil microbiological activity (Vanclay 1994; Parrotta 1999; Lamb et al. 2005). The inclusion of promising indigenous tree species along with exotic species would further improve the ecological stability and sustainability of forest plantations (Yirdaw 2002). Mixed forest plantations, therefore, should be given serious consideration in the planning and establishment of rehabilitation programs. Major considerations in the use of plantations for rehabilitation include:

- Careful and accurate matching of species to site conditions.
- Choice of species in case of mixed-species plantations with complementary growth form and rate.
- Timing of critical forest management interventions.
- Provision of adequate protection against fire and grazing especially in the savanna and drylands.

11.4.2.2 Plantations Case Study: Community Efforts at Rehabilitating Degraded Lands in the Upper East Region of Ghana

(Prepared by Dominic Blay and Issacc Abebreseh, Forestry Research Institute of Ghana)

Background

The communities of Wulungu, Naabari, Namoranteng, and Degare lie at longitude 1° 30′ -1° 45°W and latitude 10° 30′ – 10° 45′ N and have a total population of about 2,000. These communities are very near to Bolgatanga, the capital of the Upper East savanna region of Ghana. The average annual rainfall is about 900–1,200 mm and the topography is generally flat, or with a few gentle slopes. The soils are Ochrosols belonging to the family of Latosols and are generally coarse-textured and of high to medium fertility, being derived predominantly from igneous rocks. The vegetation is Guinea Savanna woodland made up of widely-spaced deciduous trees, characteristically shea (*Vitellaria paradoxa*), dawadawa (*Parkia biglobosa*) and baobab (*Adansonia digitata*) as the main natural economic species. Other dominant trees are *Azadirachta indica, Combretum* spp., *Acacia* spp., *Afzelia Africana, Pterocarpus erinaceus, Detarium microcarpum* and *Terminalia avicennoides*.

Crop farming together with livestock production constitute the principal occupation of the majority of the adult population. The collection and selling of firewood, as well as the production of charcoal represent major economic activities in these communities. About 35% of the charcoal and firewood supplied to Bolgatanga come from these areas. The women are particularly dependent on these activities as sources of revenue. The remaining 65% of the charcoal and firewood supplied to the city of Bolgatanga come from the forest reserves and off-reserve areas in the region. Consequently, area forests are highly degraded due to a high incidence of annual bush fires, overexploitation of tree resources, unsustainable farming practices and overgrazing. Degradation threatens the sustainability of wood-energy with negative

consequences for the livelihoods of the local people. The Ghana Government, with financial support from the Danish Development Agency (DANIDA), established the Traditional Energy Unit (TEU) under the Savanna Resources Management Project of the Ministry of Lands and Forestry in order to ensure an adequate supply of wood-energy through the sustainable management of the savanna woodlands.

Objectives

The development objective of the project was to ensure the conservation and community-based integrated management of the savanna woodlands for the supply of fuelwood, through efficient marketing fair pricing, equitable distribution of revenues, and efficient utilization of fuelwood. Specific objectives of the project were:

- To develop the capacity of the traditional energy sub-sector in sustainable management techniques;
- To enhance the sustainable management of the resource base; and
- To improve marketing of firewood, generate revenue and ensure equitable benefit-sharing.

Approach

The approach was entirely participatory with the Forest Services Division (FSD) providing technical services and manpower, the local communities implementing field activities, and the Bolgatanga District Assembly assisting with facilitation. Members of the community were involved in problem identification, needs assessment and the designing of appropriate interventions. A working group from the Ministry of Mines and Energy and the FSD held discussions with the whole community. This working group together with some youth and elders of the community walked through the farms, degraded farmlands, forest areas, and charcoal producing areas and water sources around the community to sensitize the community members to resource issues.

Proposed sites for the community reserve and woodlots were selected with the involvement of chiefs, *Tendanas* and *Magazias*,[3] elders, farmers, traders, unit committee members, assemblymen, wood-fuel producers and youth leaders. An open forum was held to explain the objectives and strategies of the traditional energy project and answer questions posed by community members. Several environmental, economic and social problems were identified, which helped refine project objectives. The community then agreed to release part of its relic forest for conservation and management. A committee was formed to assist in the implementation of the project. The TEU identified eight woodland reserves to be piloted for harvesting of wood-fuels and prepared management plans to guide harvesting. The project began in 2000 and ended in 2003.

[3] A *tendana* is an Earth priest or spiritual landowner in northern Ghana; a *magazia* is a local women's leader.

Fig. 11.13 (**a**) Degraded vegetation before the project (**b**) Vegetation recovery resulting from the project

Results

- A good number of people in the communities were trained and organized into 11 Natural Resources Management Committees (CONARs) to represent the communities in all matters related to traditional energy planning, natural forest management (on and off-reserve) and wood-lot establishment and maintenance. The CONARs acted as the mouthpiece for the pilot community and a link between the TEU, FSD, District Assembly and the entire community. The CONARs mobilized the rest of the communities to plant trees, patrol the forest reserves, enact and enforce by-laws and to guide natural resource management and utilization in the respective communities. However, the CONARs were often challenged by some community members who did not recognize the legality or the authority of these committees.
- Up to 11 fire prevention squads were formed, trained and equipped to educate the general communities in simple fire management techniques and in understanding the negative effects of repeated bush fires.
- Specific results with regard to off-reserve management activities, woodlot establishment, and the implementation of management plans, are presented below.

Off-Reserve Management

About 3,600 ha of woodlands outside the reserves were surveyed, mapped, inventoried and reserved by the pilot communities for future production of wood-fuels. Communities formulated local rules and regulations based on traditional norms and values to manage the demarcated areas. The rules and regulations encompassed access to land, rights and responsibilities, bushfire management, harvesting of trees, species protection and unauthorized encroachment. As s a result the vegetation in the forest has increased. (Compare Fig. 11.13a, b).

Establishment of Community Woodlots

A total of 70 ha of woodlots were established under the project, using indigenous species to rehabilitate degraded woodlands and provide alternative sources of fuelwood and income for the communities. These community woodlots were planted on communal lands donated by the *Tendana*, whose powers have been challenged in recent years; some of them leading to conflicts. Many in the communities were reluctant to work on the communal woodlots because the boots and cutlasses promised to them by the project were never delivered. As a result of the above two difficulties, the concept of private woodlots emerged strongly during the second year of the project. Many privately owned woodlots subsequently were established by individuals and groups of individuals.

Implementation of Management Plans

The implementation of the harvesting schedules, detailed in the management plans, was fraught with difficulties, as the local communities did not understand them.

Reasons for Success

The project was however quite successful, as many of the objectives pursued were largely achieved. Reasons for the success include the following:

- A participatory planning process involving all stakeholders was followed;
- Enactment of community by-laws;
- Formation of implementation and surveillance committees by the local community.

Shortcomings

The success of the project was however less spectacular due to the following obstacles:

- The issue of land ownership was not explicitly addressed. This limited private initiatives in woodlot establishment and management;
- Multi-purpose use of the reserve was not fully explored during the participatory planning phase. This contributed in part to the difficulties in implementing the harvesting schedules drawn up within the management plans.
- The management plan was more on the technical aspects and ignored the economic and social perspectives. This also contributed to the difficulties in implementation.
- Unfulfilled promises on incentives (boots and cutlasses) coupled with a lack of clear policy and legal backing at the national level to community institutional initiatives also added to the difficulties and conflicts with local law enforcement committees.

Lessons Learnt

A number of interesting lessons derive from this case study, including the following:

- A natural process of recovery can be an effective option for rehabilitation of degraded lands (Fig. 11.13a, b).
- Land and tree ownership issues need to be resolved beforehand to avoid conflicts.
- Without policy and legal backing at either the district or national level, community-based initiatives are not easily implemented.
- Participatory planning is essential to successful project implementation. However such planning should consider all issues, technical, socio-economic and cultural, which have some bearing on the project and should involve all stakeholders.
- Failure to deliver on promises reduces communities motivation to work on community projects

Recommendations

- A clear-cut national policy on community forest reservation and management must be put in place to give legal backing to community initiatives.
- The issue of land ownership should also be resolved through an open forum.
- Planning for rehabilitation of degraded lands should be holistic and should involve all stakeholders and address major issues which could limit successful implementation of project activities.
- A multi-purpose land use approach should be used in managing degraded forests.
- Studies should be conducted on natural processes of recovery to determine recruitment of species, composition and structure of the vegetation at different stages of recovery, the impacts of these on the soil and the phenology of the different plant species.

11.4.2.3 Case Study: Rehabilitation of Degraded Forests Through the Collaboration of Local Communities in the Dormaa District of the Brong Ahafo Region of Ghana

Background

The project was undertaken in nine rural communities covering three forest districts, Woranteng and Ahenkora in the Begoro Forest District, Nsugungua, Deworoworo No. 1, Deworoworo No. 2 and Bininita in the Offinso District and Kofiasua, Twum kurom, Abonsrakurom and Ntabene in the Dormaa District. The population of these communities is about 3,000 and the major occupation of the people is farming of both cash and food crops. All communities are in the moist and dry semi-deciduous forest ecological zones of Ghana, between latitudes 4° 30′and 8° N in southern Ghana. Mean annual rainfall ranges from

1,250 to 1,500 mm. The mean daily temperature ranges from about 25°C in the wet season (March-October) to about 27°C during the dry season (November – February). The project area is underlain by Precambrian schists, phyllites, greenstones, greywackes, and other metamorphic rocks of Birimian and Tarkwian formations folded along axes running northeast to southwest and by associated granites (Burnham 1989). In the flat to moderately steep terrain, these rocks are frequently covered by Latosols. They are old highly weathered soils comprised largely of kaolinite and sesquioxides of iron and aluminum. Humus content and cation exchange capacity are rather low (Hall and Swaine 1981), resulting in relatively infertile soils.

All natural and secondary forests in this zone fall in the category of tropical semi-deciduous forest (UNESCO 1973). Hall and Swaine (1976) described them as having more or less uneven tree canopy and with heights of between 10 and 40 m. However, some emergent trees reach 60 m and woody climbers are always present. Vascular epiphytes are present, but not abundant. Gymnosperms and stem succulents are absent and palms are generally uncommon. The area is the most productive forest zone of Ghana with a soil structure and content ideal for most of the forest zone crops including cocoa. Cocoa and other crops are very much evidenced all over the moist semi-deciduous forest area where there is a great demand for more farmland. Other crops, apart from cocoa, usually planted by farmers in this zone are plantains, cocoyam (*Xanthosoma* spp.), maize and to a lesser extent vegetables. These farming activities are largely restricted to subsistence agriculture. Thus repeated clearing, burning and farming coupled with heavy exploitation of timber trees in the area have extensively degraded most of the area (Fig. 11.2). Although yields of food and cash crops have not been documented, farmers perceive that current yields are drastically lower than they obtained some years back. The need to rehabilitate these degraded lands and make them productive again is a real concern for the local populations. For these reasons the Forestry Research Institute of Ghana and the Institute of Renewable Natural Resources of the Kwame Nkrumah University of Science and Technology undertook the project to rehabilitate the degraded areas, in partnership with the Forestry Services Division and the local communities, with financial support from the International Tropical Timber Organization (ITTO).

Objectives

- To determine underlying causes of degradation and the impact of degradation on the lives of the local communities;
- To establish, with the collaboration of local communities, demonstration plantations that could serve as models in rehabilitating degraded forest lands;
- To determine the costs of establishment, maintenance and protection of plantations by the communities;
- To produce guidelines for use by other local communities.

Approach

The strategy used was to provide the local communities with the technical expertise and guidance to establish plantations in the degraded areas while at the same time eliciting from them their knowledge on degradation. Plantation establishment was selected rather than natural regeneration because the degraded areas were characterized by nutrient-deficient soils, reduced primary productivity, and low biological diversity. Natural regeneration in such areas is therefore slow and cannot rapidly rehabilitate the areas within a timeframe compatible with short-term human needs. Artificial regeneration on the other hand is faster.

Consequently, the first major activity was the organization of a start-up workshop organized in collaboration with the respective district assemblies to bring together all the stakeholders in the project within the communities. The workshop was designed to:

- Introduce the project to the communities;
- Ensure that all actors and stakeholders understood the project concept, the opportunities, limits and modalities, as well as the roles and responsibilities of the various actors;
- Enable the project team to capture preliminary data and information that would be useful for planning detailed field activities in connection with the project;
- Ensure agreement on subsequent activities and secure maximum co-operation from all stakeholders; and
- Determine how participation can be sustained throughout the project cycle.

Activities

- Identify the major causes of land degradation and the most appropriate measures to address them, including species to be used for plantation establishment as well as appropriate methods of maintaining rehabilitated areas by local communities.
- Design and administer questionnaires and establish focus group discussions to elicit responses of the local communities on underlying causes of deforestation and degradation of forests near the communities, impact of degradation on the forests as well as on the livelihoods of the members of the community, appropriate measures to be taken that would address the causes, indigenous species to be used for the rehabilitation of degraded areas by local communities, appropriate methods to be used to establish, protect and maintain plantations established in the degraded areas.
- Establish demonstration plantations in degraded forest areas with the active collaboration of local communities.
- Train local communities in production of planting materials (seedlings and vegetative propagation materials) of the species they would use to rehabilitate the degraded areas; site preparation for block planting, enrichment planting and taungya; planting methods; methods for assessment of survival and monitoring of growth; and methods for maintaining and protecting the planted areas.

- Community members were provided with logistics and technical advice on propagating methods for the species that were used; site preparation appropriate for block planting, enrichment planting and taungya; the site preparation and planting activity; how to assess survival and monitor growth; and protection methods from human encroachment, fire, animals, diseases and pests.

Results

Perceptions of community members on the underlying causes of degradation and its impact on local communities included poverty, inequitable sharing of benefits from the timber royalties, non-involvement of local communities in forest resources policy formulation, as well as failure of the Forestry Commission to educate the local communities on current forest policies and legislation. The local communities were particularly aware of loss of non-timber forest products (NTFPs), especially bushmeat; soil fertility loss leading to decreased crop yields, leading in turn to reduced income; and reduced flow and sometimes complete drying up of streams and rivers. They also highlighted an increase in annual bush fires as result of increased growth of *Chromolaena odorata* and *Imperata* grasses, which increased fuel loads and led to more intense wildfires.

Forest nurseries were established in all the local communities to produce seedlings for the plantation establishment and for sale to other agencies (Fig. 11.14a). Local communities have established about 100 ha of plantations interplanted with food crops (Fig. 11.14b) and this has matured into plantation forest of indigenous species after 4 years (Fig. 11.14c). The local communities also indicated that their annual incomes have increased as a result of the sale of food crops from the plantations but that is yet to be confirmed.

Reasons for Success/Failure

The project succeeded mainly because:

- The project objectives were consistent with the needs and constraints of the local communities.
- Objectives, the project implementation processes, and the expected benefits were clearly explained and understood by local communities.
- The local communities had a genuine interest in using their lands to produce both food crops and NTFPs; the project just provided an entry point into that dual need.
- The local communities benefited from the project, in terms of food, NTFPs and income generation.
- Appropriate incentives were provided to the local people within the project in the form of equipment (boots and cutlasses), which were needed to obtain their effective participation in the implementation activities.

Fig. 11.14 (**a**) Community forest nursery, (**b**) Taungya method, stand interplanted with food crops, (**c**) Mature plantation

Despite its significant success, the project registered a number of shortcomings:

- The issue of who becomes responsible for the maintenance of the plantations when the farmer moves to new areas was not resolved. Likewise how the project can be sustained after ITTO funding has ceased has not yet been resolved.
- Lack of technical guidance when the communities need it because the services of part-time staff of the Forest Services Division were sometimes unavailable.
- Lack of documentation on the actual area planted by individual members of the communities and what their benefits from this will be.
- Lack of information on the optimum planting distances for trees and food crops to ensure maximum yield of food crops and optimum growth of trees.
- Lack of information on the socio-economic conditions of the participating communities and the impact the project is having on them.

Lessons Learnt

- Project start-up workshops are useful to ensure success of projects involving many partners, including local communities. Such workshops provide opportunities to discuss and clarify issues, which may compromise effective participation and commitment from all the actors, especially local people.

- The issues and arrangements to be discussed, clarified and agreed upon must include roles and responsibilities of each actor or partner, the concerns and needs of the local people who are the immediate beneficiaries, as well as benefit-sharing arrangements. Meeting some of these needs at the start of the project can stimulate effective participation from some actors (i.e., boots and cutlasses for the local people in this case study).
- Personnel supervising projects and providing technical advice should be full-time so that they will be available when farmers and other local community members need them.
- Pre-project baseline data on local communities (socio-economic conditions) are important to fully assess project impacts later.

Recommendations

- Maintenance of project areas rehabilitated and how the project is to be sustained after donor funding ceases should be clearly be resolved at the beginning of the project.
- A project should always have full-time technical personnel who will always provide technical guidance at all times.
- Research should be initiated to determine appropriate planting distance for the taungya system to enhance productivity of both food and tree crop;
- Ex-post project impacts assessment studies could investigate how the taungya system could better contribute to poverty alleviation.

11.4.3 Physical Structures for Soil and Water Conservation

Soil and water conservation techniques entail creating structures which improve the retention of water for plant growth and reducing soil erosion. The structures are generally micro-catchments of different types including: square, V-shape, W-shape, line barriers and tie-ridging. These techniques are more suitable for the dry sub-humid and dryland areas, which experience severe moisture deficits. The techniques are, however, generally labor-intensive.

11.4.3.1 Case Study: Rehabilitation of Degraded Lands in the Lake Chad Basin, Cameroon

(Compiled by Dr. Eyog-Matig, Coordinator, IPGRI/SAFORGEN, c/o IITA 08 BP 0932 Cotonou, Benin)

Background

The location of the project is Maroua, Northern Cameroon at an altitude of about 300 m above sea level, with a mean annual rainfall of about 700 mm. Population is about 100,000 people. The soils of the area are mainly Vertisols and the vegetation is of the Sudano-Sahelian savanna type; *Acacia* spp. are the predominant vegetation. Crops (mainly the coarse grains, sorghum and millet) and livestock farming are the dominant livelihood activities. A pre-project survey estimated that some 13% of the total land area of the Maroua region was degraded due mainly to mechanized cotton cropping by hundreds of local farmers with fertilizer inputs supplied by the cotton industry (SODECOTON). Other causes were shifting cultivation, overgrazing, over-harvesting of fuelwood, uncontrolled exploitation, and high population pressure (see Fig. 11.1).

Objectives

- To rehabilitate the degraded areas to make them productive;
- To demonstrate restoration techniques to the local communities.

Approach

The executing agency of the project was IRAD (Development-oriented Agricultural Research Institute). Active project partners were administrators and local authorities; local farmers were passive partners in that they participated in the project only as hired labor. The approach combined use of water-harvesting techniques with agroforestry. Five water-harvesting techniques were used: small dams (4×4 m, 15 cm high); half-moon depressions (20 cm wide and 20 cm deep); Zai method (1.5 cm long, 30 cm wide and 30 cm deep); plowing with bulldozer (40 cm deep); and planting holes (40×40×40). Agroforestry methods used planting exotic and indigenous tree species, planted at a spacing of 4×4 m. The exotic species were *Azadirachta indica* (for fuelwood, medicinal, and pesticidal usage); *Eucalyptus camadulensis* (for poles, and fuelwood); and *Dalbergia sissoo* (for fodder). The indigenous species were *Acacia nilotica* (for tannins and fuelwood); *Acacia senegal* (for gum arabic, fuelwood and fodder); and *Sclerocarya birrea* (for wild fruits).

Project Inputs

- The human inputs included a research team composed of soil scientists, foresters, hydrologists, and social scientists and local farmers used mainly as hired labor.
- The financial inputs included the costs of preparation and establishment of the different techniques (plowing with bulldozer at USD 384 ha^{-1}; small dams at USD 268 ha^{-1}; Zai method at USD 317 ha^{-1}; half-moon at USD 217 ha^{-1}; and planting holes at USD 134 ha^{-1}).

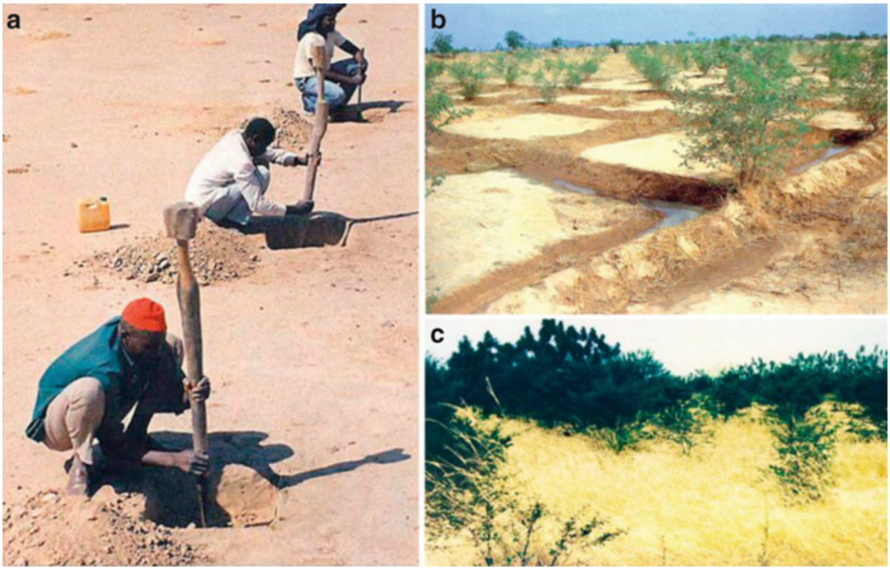

Fig. 11.15 (**a**) Severely degraded site, (**b**) Rehabilitated site, (**c**) 4 years later

Results

After 2 years of rehabilitation work, the project site was on the way to recovery as can be seen by comparing the severely degraded site (Fig. 11.15a) with the rehabilitated site (Fig. 11.15b). Four years later, further improvement in the project site was observed (Fig. 11.15c). The survival of different tree species varied considerably. Indigenous species were more tolerant to drought than exotic species. Exotic species showed faster growth, which seemed to stabilize 4–5 years after planting. Thinning exotic species after 4 or 5 years seemed to boost their growth. Local species showed a slow but extended growth period. The evidence indicates that farmers can use both exotic and indigenous tree species in addressing their wood needs. Early-maturing exotic species could be harvested for poles and firewood, while local species are conserved and harvested later for fruit, timber and other purposes.

Reasons for Success and Lessons Learnt

Success can be attributed to the following factors:

- Appropriate utilization of scientific background information (past research results on farmers' preferences for tree species and on tree planting distance were utilized in implementing the project).
- Judicious use of farmers' practices and experience; the water-harvesting techniques used in the project were not totally new to the farmers in the area; they were improved versions of their traditional practices.

- Integration of tree crops into agricultural systems, yielding diversified products (fuelwood, fodder, poles, wild fruits, medicine and pesticide, tannins and gum arabic).

  Nevertheless, there were shortcomings:

- Inadequate participation of farmers in the project (the project was designed and implemented with little local participation. This may not facilitate adoption of project results by farmers).
- Non-integration of food-crops into the system (although the design of the system had the potential to integrate crops, this was not realized).
- The trials covered a small land area and costs were high (costs per ha for the bulldozers and agricultural tractors for land preparation might have been significantly reduced if a wider area had been covered).

Recommendations

- Political support from public and local authorities is essential for smooth implementation and success of the project.
- Land tenure should be clearly resolved for greater adoption and sustainability.
- Participatory processes should be adopted in project planning and implementation to ensure increased local support and project sustainability.
- Extension services should be associated with the project to ensure timely dissemination of project results.
- Research on economic and technical feasibility of the system at farm level should be carried out, including alternative and cheaper water-harvesting techniques; identification and design of the best agroforestry practices to improve the existing framing system, including studies on alternative tree species, micro-catchment design, and compatibility of food crops and tree species.

11.4.4 Natural Regeneration

Natural regeneration involves deliberately managing the land to enhance and accelerate the natural processes of ecological succession in order to re-establish a healthy and resilient forest ecosystem (Fig. 11.16). Naturally colonizing shrubs may play a critical role in improving adverse conditions and aiding succession in abandoned tropical pastures (Fig. 11.17). Seeding early-successional shrubs may be an inexpensive strategy to accelerate recovery in regions where shrubs facilitate tree seedling establishment; unlike most tree species, many shrubs produce copious amounts of seeds that are easily collected year-round (e.g. *Lantana* spp, *Solanum* spp, *Grevillea banksii*, etc.). Care is required as these species can easily become dominant and can hamper the establishment of other desired species. It is better to

Fig. 11.16 Natural regeneration in a plantation of *Terminalia* spp.

Fig. 11.17 Some wildlife areas in the savanna are also being restored using this technique

avoid introducing shrubs that have little socio-economic value. Figure 11.16 shows natural regeneration which is taking place in a *Terminalia* species plantation and Fig. 11.17 also shows natural regeneration which resulted in a secondary forest.

11.4.5 Assisted Natural Regeneration and Enrichment Planting

Assisted Natural Regeneration is used to accelerate regeneration by assisting natural processes and it involves cutting or pressing down the weeds around existing naturally occurring seedlings, protecting the site from fire and inter-planting with desired species if necessary. The FORUM project in the Volta region is using these techniques as part of their restoration strategies[4].

In the Shinyanga region of Tanzania, the local communities have provided a key tool for forest restoration, with their indigenous natural resource management system called "ngitili", which involves conservation of fallow and range lands by encouraging vegetation regeneration, particularly for browse and fodder. The Sukuma people have had to deal with erratic and poorly distributed rainfall with high variability between seasons, so they have developed a response to acute fodder shortages caused by long and frequent droughts.

The Shinyanga region used to be extensively forested with dense woodland and bush land species, and good cover of understorey grasses. Natural vegetation was originally woodland and bush land with species such as *Acacia, Brachystegia, Albizia, Commiphora* and *Dalbergia*. However, due to severe deforestation, many areas turned treeless except for a few acacia and baobab trees. The vegetation has gradually reverted to an open bush savanna. Massive deforestation has taken place through shifting cultivation, tsetse fly and bird (principally *Quelea quelea*) eradication control campaigns in the early 1920s and 1930s. Most recently, extensive grazing has led to soil fertility decline and degradation with subsequent low crop yields, shortage of dry season fodder, scarcity of fuelwood and construction poles, and severe wind and soil erosion (MNTE 1995). The impacts of intensive cropping leading to clearing of land for agricultural expansion, rapidly declining land productivity, and shortages of herding labor, created a need for forest restoration. The response has been the establishment of communal *ngitilis* – with an average size of 50 ha – which together with individual *ngilitis* now cover over 350,000 ha of restored woodland. The traditional *ngitili* system of the Sukuma people provided a good entry point for forest restoration through local community efforts.

Objectives of *ngitili* have been expanded to cover other wood products and services required by the community while retaining the original objective of providing fodder for the dry season. *Ngitili* areas have conserved soil and reduced erosion, consequently contributing to improvement of agriculture and livestock production.

[4] Mr. Winfred Bimah, Volta Regional Forest Project Manager, cited in "FORUM Project fighting forest degradation in Volta Region," Modern Ghana, 5 December 2007 (http://www.modernghana.com/news/149278/1/forum-project-fighting-forest-degradation-in-volta.html).

Important naturally regenerating indigenous trees are being left and managed on farm and grazing land. To ensure that the *ngitili* were guarded and respected, traditional law known as *mchenya* was applied, supervised by the village security committee (Chamshama and Nduwayezu 2002).

11.4.5.1 Case Study: *Ngitili*, a Traditional Method of Land Rehabilitation in Shinyanga Region, Tanzania

Background

The Shinyanga region is situated in northwestern Tanzania, south of Lake Victoria at latitude 2–5° S and longitude 31–35° E. The region has eight administrative districts and covers an area of 50,764 km^2 of which 31,140 km^2 is arable land, 12,079 km^2 grazable land and 7,544 km^2 forest reserves (HASHI 2002). The present population is about 2.6 million people and population density varies between 18 people km^{-2} in Meatu District to 183 people km^{-2} in Shinyanga Urban District; the regional average is 35 people km^{-2} (HASHI 2002). Altitude varies between 1,000 and 1,500 m above sea level. Rainfall ranges between 650–1,000 mm with a mean of 700 mm. Monthly temperatures vary between 27.6 °C to 30.2 °C (maximum 15 °C and 18.3 °C minimum). The region is characterized by small hills, separated by *mbuga* (flooded or poorly-drained black clay soils) plains and gentle slopes. On hilltops, soils are moderately well-drained grayish brown sands (Ferric Acrisols and Oxisols). Moderately deep well-drained, grayish brown sandy loams (Ferric Luvisols) occur on the slopes. On the low-lying bottom lands, soils are the poorly-drained *mbugas* (Cambisols and Vertisols). Vertic soils are very extensive covering 47% of all soil types in the region. Ecologically, Shinyanga region falls under the uni-modal rainfall plateau. In this agro-ecological zone, a system of agro-pastoralism called *ngitili* is practiced. *Ngitili,* which means leaving an area closed to allow grass regeneration for use during the dry season is an indigenous silvopastoral technology used to alleviate dry season fodder supply shortages, to conserve and protect soils and to reclaim degraded land (Kilahama 1994; Maro 1995; Msangi 1995). Maize is the main food crop, followed by sorghum and rice; cotton is the main cash crop. Livestock is an important component in the system; production is generally extensive, based on traditional communal grazing.

In 1986, because of the severe land degradation problems of the Shinyanga region, the Government of the United Republic of Tanzania started a land rehabilitation program called HASHI, which in Kiswahili stands for Hifadhi Ardhi Shinyanga (Shinyanga Land Rehabilitation Program). From 1991, HASHI received financial support from the Government of the Royal Kingdom of Norway through the Norwegian Agency for Development Cooperation (NORAD). At the same time, funding was also extended to agroforestry research in collaboration with the World Agroforestry Centre (ICRAF). HASHI worked in tandem and served as an extension arm of the HASHI/ICRAF research project by disseminating tested technologies such as management of woodlots and improved fallows. HASHI activities were phased out in 2002, and the respective district authorities now handle all activities.

Objectives

The overall objective of the HASHI project was for communities to use sound practices and technologies to manage the natural resources on a sustainable basis. This objective focused on the following key outputs:

- To secure increased awareness on natural resource management among actors.
- To articulate and implement improved land-use planning mechanisms and natural resource management practices.
- To strengthen institutional capacity for extension, monitoring and evaluation.

Approach

HASHI collaborated with regional and district agricultural, natural resources and community development staff and the local communities to implement the project. The project gave emphasis to the re-establishment of *ngitili* as well as other traditional natural resource management (NRM) techniques. Grazing under *ngitili* normally starts from July/August after crop residues and forage in fallow areas has been depleted. Animals are removed from *ngitil*i after all the fodder is exhausted or when fodder becomes available outside the *ngitili* (Kilahama 1994; Otsyina and Asenga 1994). In order to achieve project objectives, various approaches and methods were employed aimed at greater participation of the community in every aspect of NRM. These approaches included participatory rural appraisal (PRA), video and film shows, study visits, farmer-to-farmer visits, traditional dances (*ngomas*), theatre drama, publications (posters, newsletters, books), meetings, workshops, seminars, exhibitions, demonstration plots, youth camps and school excursions (HASHI 2002).

The main activities included:

- Seedling production and tree planting, land reclamation and soil and water conservation.
- Community participation and empowerment through training and awareness creation in adoption of sound land use practices and capacity building.
- Promotion of indigenous natural resources management practices with emphasis on natural regeneration (in situ conservation - *ngitili*).
- Development of agroforestry systems (e.g. homestead, on-farm tree conservation and planting, boundary planting, fodder banks, improved fallows and rotational woodlots).
- Development of alternative forest uses and income generating activities through establishment of commercial household tree nurseries, beekeeping and improved cook stoves.

Results

Over the 15 years of the HASHI project in its different phases, significant progress has been recorded (Nshubemuki et al. 2003):

- Increasing environmental awareness among the Shinyanga communities, government leadership, Non-Governmental Organizations (NGOs), Community-Based Organizations, local institutions, schools, and individual farmers.
- About 180 villages have been involved in management of fodder banks in *ngitili*, each with about 540 ha. About 70% of the households in the region have been able to reestablish their traditional *ngitili* covering over 350,000 ha with huge dividends both for the natural environment and the livelihood of the communities. This practice has begun to enhance land tenure and reduce the traditional conflict-prone free grazing. There has also been a spill-over into non-project areas as well as reactivation and strengthening of indigenous institutions as regards NRM and grazing (HASHI 2002).
- Homestead tree planting (mainly indigenous species) and management of scattered trees on farmland was also promoted; about 15 trees ha^{-1} were retained in 2002 as compared to 5 trees ha^{-1} in 1998.
- Promotion of community and private tree nursery establishment and eco-museum development that involved documentation of indigenous technical knowledge.
- Training of over 3,000 people including community groups that included 30% women
- Village Environmental Committees (VEC) were established and environmental conservation by-laws formulated both at village and district levels. The by-laws have facilitated control of overgrazing, encouraged fire protection, tree growing, tree harvesting and control of charcoal burning.

In the course of conceiving *HASHI* and implementation of planned interventions, some weaknesses were evident (Nshubemuki et al. 2003):

- *HASHI* was traditionally planned as a central government project under the Ministry of Natural Resources and Tourism with very limited participation of the regional authorities and districts as well as other stakeholders in the region.
- The project lacked baseline studies.
- Limited extension staff has resulted in inadequate extension services in all parts of the region.

Reasons for Success and Lessons Learnt

The success of the traditional *ngitili* system and other sound land use technologies in Shinyanga region can be attributed to awareness-raising, community participation and empowerment that resulted in reestablishment of this traditional land management and other land management systems.

Recommendations

- *Ngitili* is a useful land use system, which needs to be scaled up to other districts of Shinyanga and other areas with similar ecological conditions. It is recommended

that the policy makers put in place an enabling environment for wide-scale adoption of the system.

- Communities should be trained in *ngitili* management to ensure adequate fodder availability.
- The *ngitili* need to be improved to increase the availability of high quality dry season fodder and wood based products. Research is needed on: introduction of improved fodder grasses, planting of fast growing fodder trees and/or shrubs, and determination of thinning regimes to encourage grass growth.
- The impact of the *ngitili* system on the livelihood of local communities needs to be documented.

11.4.6 Enrichment Planting

Enrichment planting has commonly been used for the restoration of logged primary forests and for increasing the wood volume and economic value of secondary forests. The experience with enrichment plantings in secondary forests has generally been more favorable than when applied in primary/logged-over forests. The success of enrichment plantings has been variable and its efficacy questioned; the use of this silvicultural option has declined in the tropics. Some of the reasons cited include: planting work is difficult to supervise; seedlings have to be regularly released from re-growth; a regular supply of seedlings is needed; and it is costly (labor-demanding). In general, failures are attributed to the poor selection of species, the lack of adherence to sound planting and tending practices, or both. Other factors contributing to the poor reputation and expensive failures associated with enrichment planting are insufficient overstory opening prior to planting, insufficient follow-up tending, and pest attack. There are, however, biological, environmental and economic arguments in favor of enrichment planting. When compared to other artificial regeneration systems, enrichment planting has the advantages of mimicking natural gap dynamics and protecting the soil by maintaining vegetation on site. Necessary conditions for successful enrichment planting include the provision of adequate light conditions, proper supervision, and follow-up maintenance (especially canopy-opening treatments).

11.4.7 Agroforestry

Restoration agroforestry involves two stages. In the first stage, tree or shrub species or both are planted on degraded forestland together with any necessary mycorrhizal or rhizobial symbionts, with the objective of checking erosion and increasing soil organic matter and fertility. In the second stage, the cover may be selectively removed and agricultural production introduced (Young 1989, 1995; Kieppe and Rao 1994), Because time is needed to build-up the enhanced plant-litter-soil nutrient cycle (Kellman 1979; Kessler and Wiersum 1995), exploitation of the vegetative biomass should be kept low with necessary protection from grazing, harvesting or fire.

The initial tree and shrub removal can be in strips along contours with belts of trees remaining. This leads by stages to hedgerow intercropping (Young 1995). Other options include fodder incorporation along strips or multi-story systems (Young 1989, 1995).

Agroforestry can be practiced in any of the ecological zones. It can be a way to reduce deforestation or land clearing and to increase crop yields and the diversity of products grown, but an additional benefit is the creation of a C sink that removes CO_2 from the atmosphere, or the maintenance of C in existing vegetation and, therefore, has implications for climate change (Shroeder 1994). Agroforestry, being one of several approaches for improving land-use, is also frequently invoked as an answer to shortages of fuelwood, cash income, animal fodder and building materials in SSA (Rocheleau et al. 1988). Rehabilitation agroforestry is a new technique for land rehabilitation, thus constraints are now gradually emerging and they likely will be site-specific.

11.4.7.1 Case Study: Joint Management as an Option for Rehabilitating Degraded Forests: The Case of the Gwira Banso Project in the Wassa West District of the Western Region of Ghana

Background

Gwira Banso is located in southwest Ghana (latitude 3° 30′–3° 45′ and longitude 5° 25′–5° 30′). The population of about 5,000 is mostly made up of the indigenous Gwira people and migrants who are mostly Ashantis, Krobos, Fantes and Brongs. The average annual rainfall is the highest in Ghana at 1,700–2,000 mm. The area is characterized by tropical high forest of the wet evergreen type on highly acidic Latosols that are generally unsuitable for growing cocoa. The major occupation of the people is farming using slash and burn; although cocoa is the major cash crop planted, because of the highly acid soils cocoa yields are generally low. The damp conditions under the high forest canopy produces black pod diseases, which reduce yields of cocoa. Thus the farmers abandon their farms after a few years, and clear new forests for new farms. The abandoned lands are used subsequently for food crop farming after a short fallow period of 3–5 years. Logging has also been extensively practiced for many years using indiscriminate felling practices. Therefore land abandonment from farming and logging has degraded some areas (Figs. 11.2, 11.3, 11.4, 11.5 and 11.6).

In 1994, as a result of its growing business interest in Ghana and backed by its newly developed environmental policy of supporting worthwhile initiatives towards sustainable forestry, Dalhoff Larsen & Horneman (DLH) began discussions with one of its business partners, Ghana Primewood Products Ltd. (GPP) to set up a joint forest management project. Ghana Primewood Products Ltd. had at the time also embarked on a program of good forest management practices as a tool for marketing timber and wood products in view of worldwide trends towards sustainable forest management. Later the same year, the two partners approached the newly formed office for the DANIDA Private Sector Development Programme (DANIDA/PSD-Programme)

at the Royal Danish Embassy in Accra for funding to support the forest management project.

In September 1995 an agreement was reached with the DANIDA/PSD-Programme to provide a grant of DKK 2,150,000 (USD 335,937) for the first phase of the project, which had a total cost estimated at DKK 3,840,000 (USD 600,000). The two commercial partners funded the balance between the estimated cost of the project and DANIDA support. These partners were to collaborate with the chiefs and people of Gwira Banso, the Forestry Service of Ghana, the Ministry of Food and Agriculture and the Nzema East District Assembly to undertake a pilot project of jointly managing the resources of a 16,000 ha off-reserve area. The first phase of the project ran for 3 years and sought to introduce Joint Forest Management and collect data for sustainable forest management; it focused on farmers as the main agents of change. After this period, the project partners generally agreed with DANIDA PSD-Programme that "the project had collected many important data and began developing methods for sustainable natural resource management in collaboration with the stakeholders." In addition, it had successfully introduced the concept of Joint Forest Management; due to its innovative nature, the project had attracted much attention.

The authorities in Ghana saw it as a model for replication in other off-reserve forest areas. However, the project had not yet fully achieved sustainability of the forest resources in the area. For these reasons, a second phase of the project was begun in 1999; this time it was oriented in a more commercial direction but still working within the framework of Joint Forest Management. A further grant of DKK 1,976,823 was approved for support by the DANIDA PSD-Programme. The second phase had as its main objective to ensure that the project produced timber on a sustainable basis, including those species considered lesser-used, for processing by the Ghanaian partner and for marketing and sales through DLH.

During the second phase, CARE Denmark and CARE Ghana, which provided most of the direct support to farmers in the first phase, were implemented within the existing project structure. Thus a unique opportunity was created to implement a sustainable and commercially sound resource management system with the involvement of local people, two business partners, DANIDA, an NGO, and the Ghanaian authorities in forest management and agriculture.

Objectives

The developmental objective was to develop jointly a sustainable natural resource management system for the rehabilitation of degraded lands in off-reserve forests and to enhance the livelihoods of forest-dependent communities through increased benefits.

The specific objectives were:

- To promote sustainable forest management in a farming environment;
- To increase production of wood from the project area through identification, utilization, and promotion of lesser-used timber species available in the area and elsewhere;

- To develop land use guidelines and promote sustainable agricultural practices in the project area leading to improved livelihoods for the individuals and communities in the area; and
- To implement village-level development activities with funds contributed to a community development fund by the timber companies.

Approach

The approach used in the project involved mobilizing and fostering close partnership among forest sector stakeholders. The implementation strategy included a division of responsibilities; DHL was to provide technical assistance, training and technology transfer on the various activities of the project through its staff in both Ghana and Denmark. All training and technical assistance took place in Ghana except for a short training period of about a month on Low (Reduced) Impact Logging held in Brazil.

Stakeholder Consultations

At the beginning of the project, a series of consultations was held with various stakeholders, principally local landowners and farmers, the District Assembly (the political authority of the area), the Ministry of Food and Agriculture and the Forest Service of Ghana. The meetings were used to explain project aims and objectives, solicit views for improvement, and seek the participation of the people.

Field Activities

Fieldwork began in 1996 with 2-week training for some forest operations staff of GPP in inventory techniques for timber stocks and a survey of some non-timber forest products. After these initial surveys, further project activities were implemented focusing on specific objectives related to forest management and agriculture to improve livelihoods.

The *taungya* system was used, which involves planting trees on wide-spacing and intercropping with food crops until canopy closure. Farmers chose indigenous species limited to those native to the area. Species were planted on farms in mixed stands in the same proportions as they occurred in native forests, at a rate of 20–40 seedlings per ha depending on the wishes of the farmer and the crop being cultivated. The species included *Khaya ivorensis*, *Heritiera utilis*, *Tieghemella heckellii*, *Entandrophragma angolense*, *Nauclea diderrichii*, *Entandrophragma utile* and *Ceiba pentandra*. One exotic species was planted, *Cedrela odorata*; because this is a short-rotation timber tree, it was planted in pure stands on fallow lands with an initial population of about 1,200 seedlings per ha. The farmers were provided with free seedlings by the project. In spite of the efforts made by the

farmers to afforest the degraded areas, the project did not effectively build their capabilities on how to manage the areas after planting. Programs to sustain continued efforts on the part of the farmers were also lacking. Another issue that remained unresolved before the end of the project was that of land tenure; most of the farmers who did the planting were not the landowners and this had an impact on the restoration program.

The project initially undertook an inventory of farmers, their land holdings and crops being grown. This was to establish a database for implementing and monitoring project activities. CARE continued the process when the project ended. Development of land use management guidelines began with the physical measurement of the sizes of farms. Farmers were trained in simple techniques of using a GPS to trace their farm boundaries and to take some measurements. New cash crops more suitable than cocoa for the area, such as black pepper (*Piper nigrum*) and kola (*Cola nitida*) were introduced to farmers.

Results

- A total area of 416 ha of farmland was planted with indigenous (40%) and exotic (60%) timber tree species;
- Black pepper and kola were successfully introduced and adopted by farmers in the project area;
- An extensive foundation for sound social, economic and ecological management of natural resources was established in the project area;
- Crop and tree growing as a form of agricultural diversification was promoted along with collaborative natural resource management among farmers;
- The project created a forum for dialogue among farmers, landowners and other stakeholders to address land-tenure issues.

Reasons for Success

- Broad consultation with all partners;
- The decision by all partners to cooperate and respect each other's interest;
- Farmers chose the species to plant for restoration;
- Seedlings were supplied free to the farmers;
- Agricultural crops on farmers' fields were diversified away from the low-yield cocoa.

Shortcomings

- The land tenurial arrangements for the mostly migrant farmers were unresolved;
- There was also no arrangement for marketing of the tree products nor were benefit-sharing arrangements made in advance for such a complex project;

- Inability of the project to provide the farmers with the capacity to sustainably manage the plantations once established had the potential of eroding most of the gains of the project;
- Although the taungya system had been practiced in Ghana for a long time it had always been in the moist and dry semi-deciduous zones and not in the wet evergreen zones; appropriate technologies for the wet evergreen zone still need to be developed.

Lessons Learnt

- Understanding the psychology of people who live in or on the fringes of the forests is important if one is to succeed in winning their cooperation in a project as complex as a JFM project.
- The issue of giving "handouts"—many years of giving out incentives has in general created an expectation among people in rural areas, including those in Gwira Banso that donor-supported projects should provide "handouts" to motivate their participation, particularly if a project is brought to their doorstep. Thus when the JFM project did not provide such incentives (in the form of cash, cutlasses, or Wellington boots), many became suspicious of the real motives of the project. However, the provision of capital projects allayed their fears.
- Although the chiefs and people gave their overwhelming support to the project, the issue of land tenure and tree ownership could not be resolved because it was more complex than it appeared to be at the outset.
- The project has demonstrated that farmers can reforest degraded land in most off-reserve areas in the forest regions of Ghana.
- The project provided a unique opportunity to demonstrate the possibility of sophisticated private commercial sector entities teaming up with simple, even unlettered rural people, the public sector and NGOs to undertake a complex, inherently interest-conflicting project such as JFM.

Recommendations

- The rehabilitation of degraded lands should be the responsibility of all stakeholders. There should therefore be a national forum at which the role, responsibilities, as well as associated inputs for rehabilitation by all stakeholders are discussed.
- Consultation workshops held at the beginning of a project should be holistic, going beyond purely technical issues. Workshops should touch on all issues that will border on the project including incentives. Roles and responsibilities of all stakeholders should be made explicit.
- All arrangements made including roles and responsibilities should be clarified, defined, written and signed.
- Land and tree tenure issues as well as benefit-sharing arrangements should be clearly defined at the beginning of a project to avoid conflicts and promote coordinated activities.

- Programs that will help sustain the project after donor funding ceases should be put in place. Local farmers should be provided with the capacity to manage the trees on their farmlands.
- Appropriate taungya methods for the wet evergreen forest zone and the compatibility of different tree species mixed with different agricultural crop need to be determined.
- Appropriate spacing for planting tree and agricultural crops as well as the impact of shading on the agricultural crops will also need to be determined.

11.4.8 Restoration with Carbon Components

More than 40 afforestation projects were established by 2001, totaling more than 4 million ha (Moura-Costa 2001). The projects were voluntarily established in anticipation of expected changes in national environmental legislation that will require polluters to reduce GHG emissions. Third–party independent organizations have certified the carbon sequestrated by many these voluntary initiatives. GHG emitters have funded many of these projects to gain experience, in the light of future prospects of offsetting their GHG emissions (Trexler et al. 1999). Sometimes the investments of individuals companies or investors are pooled into carbon investment funds. For example, the world has created the Prototype Carbon Fund (PCF) and the BioCarbon Fund (BCF) (www.biocarbonfund.org). The PCF includes mostly energy- related projects with a couple of land-use and forestry projects. The new BCF provides carbon financing for projects that sequester or remove GHGs in forest and agricultural systems. The BCF aims to deliver cost-effective carbon emissions reductions, while promoting biodiversity, conservation, and sustainable development. The target size of the BCF is US$100 million.

Forest restoration projects for carbon sequestration are reality and in Africa some projects with collaboration of local communities and are being implemented. For example in Ghana, as in many developing countries, there are few reliable data for estimating current forest carbon stocks. Newly established forest plantations therefore constitute one of the largest and most immediate sources for changes in carbon stock in the country. The Government of Ghana and other organizations are presently establishing forest plantations at a rate of 20,000 ha annually. Thus the USDA Forest Service Southern Research Station has collaborated with the Forest Research Institute of Ghana (FORIG) in the USAID-funded Sustainable and Thriving Environments for West Africa Regional Development (STEWARD) Program. In 2010, they conducted a pilot program in two degraded forest reserves in Ghana to build on a restoration project begun 10 years ago to work with communities in developing a carbon monitoring methodology (Schelhas et al. 2010). Other projects being implemented in other countries in Africa; the scope of these projects is illustrated in Table 11.3. These approaches provide an opportunity to fund forest landscape restoration efforts although much is yet to be learned of the most sustainable approaches.

Table 11.3 Details of carbon sequestration projects in Africa

No.	Project title	Host country	Investor	Nature of benefit sharing	Other details
1	The International Small Group and Tree Planting Program (TIST)	Tanzania, Uganda, Kenya	World Bank BioCarbon Fund, USAID, Dow Chemical Company	Carbon rights transferred to CAAC. All others, viz. timber, NTFPs with community	Number of farmers > 300, organized in 315 groups. Live trees > 400,000. Seedlings in the millions
2	Participatory Rehabilitation of Degraded Lands	Mauritania & Senegal	GEF, Africa Dev. Bank, UNDP, National Government	All benefits belong to community. Carbon credits not claimed.	Aims to reach 80,000 people in 100 villages. Target area = 6,000,000 ha
3	Community-based Rangeland Rehabilitation for Carbon Sequestration	Sudan	GEF	All benefits including timber and NTFPs belong to local community	Area covered = 100 ha.
4	Village-based Management of Woody Savanna & Establishment of Woodlots for Carbon Sequestration	Benin	GEF	Woodlots with all products belong to local community. Information on carbon offsets n.a.	176,000 ha of land under conservation
5	Sustainable Energy Management Project	Burkina Faso	World Bank, Government of Norway, DANIDA	Carbon offsets with World Bank. All other benefits with local community	Project registered as AIJ (Activity Implemented Jointly)
6	Forest Rehabilitation in Mt. Elgon & Kibale National Parks	Uganda	FACE Foundation	Carbon offsets with FACE. All other rights with Uganda Wildlife Authority	Project registered as AIJ (Activity Implement Jointly), and has FSC Certification
7	Nhambita Community Carbon Project	Mozambique	European Union	Carbon rights with implementing organizations. All others with local community	Community receives cash payments for carbon sequestration

(continued)

Table 11.3 (continued)

No.	Project title	Host country	Investor	Nature of benefit sharing	Other details
8	Plan Vivo Project	Uganda	UK DFID, USAID, START, Tetra Pak, UK.	Timber and other biomass benefits with farmers. Tetra Pak buys carbon credits. 60% of the sale money goes to farmers	Carbon sequestration through small-scale tree planting on 5,000 ha., in 2003 alone, Tetra Pak bought 14,000 tCO_2 from the project.
9	Western Kenya Integrated Ecosystem Management Project	Kenya	GEF, Co-financed by National Government, Japan PHRD	Local community to get all timber and NTFP benefits. Carbon rights yet to be worked out	The project will promote conservation activities to control sediment and nutrient flow into Lake Victoria
10	Sequestration of Carbon in Soil Organic Matter (SOCSOM)	Senegal	USAID	All benefits with local community. Carbon rights not traded	Pilot project to assess the potential for carbon sequestration in sols
11	Commercial Plantation Projects	Tanzania and Uganda	Tree Farms AS of Norway (local subsidiaries)	Commercial plantation, all rights including carbon credits with the company	SGS Products Certification in Tanzania. 6,500 ha already planted
12	Carbon from Communities	Mali	NASA	All benefits with local communities	Mainly a research project
13	Bateke Fuelwood and Timber Plantation	Dem. Rep. of Congo	World Bank BioCarbon Fund	Timber and other benefits will be with villagers. Carbon credits may belong to World Bank and Novacel	Afforestation on 8,000 ha of degraded grass savanna for timber production and charcoal making. Will benefit 250 villages
14	Nile Basin Reforestation	Uganda	World Bank BioCarbon Fund	Timer benefits share with locals. Carbon credits with World Bank	Planting of pine and mixed native species on 200 ha. New jobs will be created
15	Acacia Community Plantations	Niger	World Bank BioCarbon Fund	Gum, firewood and timber to be shared with locals. ASI will sell carbon credits	Acacia plantations on 22,800 ha. Project will benefit 15,000 farming families in the area

16	Acacia Community Plantations	Mail	World Bank Biocarbon Fund	Gum, firewood and timber to be shared with locals. Deguessi-IEF to sell carbon credits	Acacia plantations on 14,000 ha. Extension of Acacia Community Plantations in Niger
17	Andasible-Mantadia Biodiversity Corridor	Madagascar	World Bank BioCarbon Fund, GEF	Mainly a biodiversity conservation project. Some benefits including carbon payments will be shared with locals	Afforestation on 5,000 ha and protection of 80,000 ha to conserve biodiversity
18	Green Belt Movement	Kenya	Green Belt Movement, World Bank BioCarbon Fund	Farmers will receive payments for carbon sequestration to carry out conservation activities	Project builds on the 30 year old Green Belt movement in Kenya
19	Humbo Assisted Regeneration	Ethiopia	World Vision Australia, World Bank BioCarbon Fund	Biomass benefits will be shared with local communities. Carbon payments to improve local infrastructure and food security	Restoration of 15,000 ha of biodiverse natural forest in Rift Valley. About 3,000 local households will benefit from the project

Adapted from Jindal R (2006) http://earthtrends.wri.org/pdf_library/feature/cli_fea_csequest_table1.pdf

11.4.8.1 Suggestions

Based mainly on the lessons learned from the case studies and experiences of the author and other scientists the following suggestions have been formulated and are strongly recommended as a guide to the way restoration of degraded forests in Sub-Saharan Africa.

Project Design

- Project start-up workshops are useful to ensure success of projects. Such workshops provide opportunities to discuss and clarify issues that may compromise effective participation and commitment from all the actors.
- Pre-project baseline data on local communities (socio-economic conditions) are important to fully assess project impacts later.
- All stakeholders, including local communities, should be involved both in the planning and implementation of the project.
- The project design should make provision for ensuring project sustainability through preventive measures as well as through incentives to stop the people from repeating the activities responsible for the land degradation.
- Projects must be planned to ensure sustainability of the benefits of rehabilitation when project activities come to an end, to prevent the restored land returning to its pre-project condition.
- Without delivering on promises to local communities, the motivation to work on community projects by local communities is reduced.
- Appropriate utilization of scientific background information (past research results on farmers' preferences for tree species and on spacing) as well as judicious use of traditional knowledge will enhance prospects for success.
- Farmers are traditionally conservative and incorporating farmers' practices and experience facilitates implementation of community-based programs and acceptance of new practices.
- Successful projects are those perceived by local communities to have a direct bearing on their livelihoods, i.e., the project is believed to have a clear potential to deliver tangible and short-term benefits such as wood and non-timber forest products for human and livestock consumption and for income generation.

Management

- Restoration projects have until now used traditional biophysical techniques, sometimes with little integration of social and cultural knowledge.
- Technocratic arrogance and a matching style of management (which assumes that local people have no worthwhile knowledge and no interest in forest protection and conservation) are still evident in some restoration projects.
- Too often, limited use is made of local knowledge and experience in restoration processes.

- Rehabilitation projects that use high-value trees or which improve animal fodder supply are likely to be more successful than projects with objectives restricted to the repair of biophysical degradation of soils and vegetation.
- Projects that are successful are those that use simple and inexpensive techniques and technologies (both in terms of cash and labor), and relate as much as possible to local knowledge and practice.
- Benefit sharing needs to be explicitly addressed at the beginning of a project and promised incentives delivered.
- Carbon sequestration and carbon benefits may provide funding and impetus for forest landscape restoration projects in Africa.

The Way Forward

- Lack of communication among project planners, implementation agencies and communities is frequently cited as a major cause of failure in projects. Policies and plans designed must always be clearly understood by community members and representatives so that they can be responsive to project needs and desires. To ensure sustainability of rehabilitation efforts, projects should be built on a foundation of community management and community ownership.
- Democratization and decentralization of governance enables local people and others outside the forestry sector to slowly gain a voice in the management of public forests and in forestry planning and policy.
- Decentralization of forest control and management from national agencies to local governments is creating conditions that are more conducive to local input, which enhances local participation in restoration projects.
- Appropriate policies should be adopted that allows a paradigm shift in forest governance from centralized to decentralized management involving local communities (community-based forest management or joint forest management) and other stakeholders and there should be equitable and transparent sharing of both benefits and costs.
- Most key factors which cause land rehabilitation strategies are outside the forestry sector land rehabilitation should be integrated into other sectoral strategies. In addition, national forest programs should include rehabilitation of degraded lands.
- An improved land tenure system would bring about land security and could encourage investment in land, promote higher land productivity and reduce the rate of land degradation.
- Reform of land tenure systems is thus required, but it must be based on a refined understanding of the socio-cultural conditions and local politics of individual countries Land policies should be reviewed so as to enable families and communities to have secure and clear tenure rights with appropriate consideration of traditional authorities.
- Countries, in collaboration with international institutions, should establish funds for rehabilitation, replenished partially by forestry activity revenues or carbon benefits.

- There is a need to share information and experiences and countries with similar problems need to share experiences and adapt approaches to local conditions.
- Within a country, relevant institutions should have the capacity to widely disseminate appropriate knowledge regarding natural resource management using innovative social media to overcome staffing limitations of extension programs.
- With private sector actors contributing to degradation in most African countries, their involvement in rehabilitation should be encouraged and private-public sector partnerships enabled.

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